are not limited to applying two different stimulus levels, as any number of different stimulus levels may be applied.

[0052] As mentioned above, the stimulus applied step S1*a* may be of a higher energy level than the stimulus applied in step S1*b*. The energy level is affected by the voltage level VDC used to power the inverter **3**, the switching frequency, and the amount of time for which a stimulus is applied. Increasing VDC or the amount of time for which the stimulus is applied increases the amount of energy provided. A switching frequency close to the resonant frequency of the transmitter provides a higher energy level than a switching frequency farther away from the resonant frequency. Any combination of these parameters may be varied to adjust the energy level applied in subsequent stimulus steps S1*a*, S1*b*, etc.

[0053] FIG. **9** shows an example of a double stimulus. FIG. **9** shows the stimulus waveform **91** produced by inverter **3** includes a first portion in step S1*a* and a second portion in step S1*b*. In step S1*a*, VDC is 6V, the duration is 206 μs and the switching frequency is 165 kHz. In step S1*b*, VDC is 6V, the duration is 60 s and the switching frequency is 200 kHz. Since the transmitter resonant frequency is approximately 100 kHz, the stimulus applied in step S1*a* has a switching frequency closer to the resonant frequency, which provides relatively high energy input. In step S1*b*, the energy is reduced by increasing the switching frequency. As shown, the rectifier filter capacitor Crec is fully charged before the start of step S2, and the duration of step S1 is less than in the example of FIG. **8**. FIG. **9** also shows waveform **92** showing the current through inductor L_{RES}, waveform **93** showing the voltage of node Vres**1**, waveform **94** showing the current through rectifier filter capacitor Crec, waveform **95** showing the voltage at the input of the rectifier **14**, and waveform **96** showing the voltage across the rectifier filter capacitor Crec.

[0054] FIG. **10** shows an example of a double stimulus similar to FIG. **9**, in which the energy is reduced in step S1*b* by decreasing the voltage VDC rather than changing the switching frequency. In this example, VDC is 8V in step S1*a* and then is reduced to 6V in step S1*b*.

[0055] FIG. **11** shows an example of a double stimulus similar to FIGS. **9** and **10** in which the energy is reduced in step S1*b* both by decreasing the voltage VDC and changing the switching frequency in the way described above in FIGS. **9** and **10**.

[0056] As discussed above, in step S**2** the resonance of the transmitter is allowed to decay, and in step S**3**, a temporal characteristic of the resonance decay may be measured. For example, a decay time of the resonance decay may be measured, and/or the quality factor Q may be determined. The measurement of the temporal characteristic may be performed using continuous time or discrete time measurements.

[0057] FIG. **12** shows an example of performing the measurement of step S**3** using continuous time measurements. A peak detector of controller **5** or a separate peak detector may be used to detect the envelope of the decaying waveform. As shown in FIG. **12**, measurements V(t**1**) and V(t**2**) are made at times t**1** and t**2**, respectively. The quality factor Q may be determined using the following equations.

$$\text{For } Q > 10,$$

$$V(t) = V(0)\cdot\exp\left[\frac{-\omega\cdot t}{2\cdot Q}\right];$$

$$\omega = \frac{2\pi}{T}$$

$$Q = \frac{\pi\cdot(t_2 - t_1)}{T\cdot\ln\left[\frac{V(t_2)}{V(t_1)}\right]};$$

[0058] FIG. **13** shows an example of determining Q using discrete time measurements. The peaks of the waveform as shown in FIG. **13** may be determined, then Q may be determined using the following equations.

$$\text{For } Q > 10,$$

$$V(n) = V(0)\cdot\exp\left[\frac{-2\pi\cdot n}{2\cdot Q}\right];$$

$$Q = \frac{\pi\cdot n}{\ln\left(\frac{V(n)}{V(0)}\right)}$$

[0059] As discussed above, a multi-mode wireless power transmitter may be controlled using controller **5**, which may be implemented by any suitable type of circuitry. For example, the controller **5** may be implemented using hardware or a combination of hardware and software. When implemented using software, suitable software code can be executed on any suitable processor (e.g., a microprocessor) or collection of processors. The one or more controllers can be implemented in numerous ways, such as with dedicated hardware, or with general purpose hardware (e.g., one or more processors) that is programmed using microcode or software to perform the functions recited above.

[0060] In this respect, it should be appreciated that one implementation of the embodiments described herein comprises at least one computer-readable storage medium (e.g., RAM, ROM, EEPROM, flash memory or other memory technology, or other tangible, non-transitory computer-readable storage medium) encoded with a computer program (i.e., a plurality of executable instructions) that, when executed on one or more processors, performs the above-discussed functions of one or more embodiments. In addition, it should be appreciated that the reference to a computer program which, when executed, performs any of the above-discussed functions, is not limited to an application program running on a host computer. Rather, the terms computer program and software are used herein in a generic sense to reference any type of computer code (e.g., application software, firmware, microcode, or any other form of computer instruction) that can be employed to program one or more processors to implement aspects of the techniques discussed herein.

[0061] Various aspects of the apparatus and techniques described herein may be used alone, in combination, or in a variety of arrangements not specifically discussed in the embodiments described in the foregoing description and is therefore not limited in its application to the details and arrangement of components set forth in the foregoing description or illustrated in the drawings. For example, aspects described in one embodiment may be combined in any manner with aspects described in other embodiments.